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ABSTRACT

In this study, 30 male college students from two weightlifting classes and 30 female college students enrolled in an educational psychology course designed specifically for music education majors were asked to read two ambiguous passages, each of which could be interpreted in two different ways. The first passage could be perceived as describing either a prison break or a wrestling match, while the second could be understood as detailing either an evening of card playing or a rehearsal session of a woodwind ensemble. Scores on multiple-choice tests, the content of written themes, and comments in free recall of the passage indicated a striking relationship between the subjects' backgrounds and their interpretation of the selections. These results indicate that high-level schemata provide the interpretive framework for comprehending discourse. The fact that most subjects reported being unaware of alternative interpretations suggests that schemata can cause people to "see" a message in light of their own frame of reference. Tables of findings are included. (Author/KS)

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FRAMEWORKS FOR COMPREHENDING DISCOURSE

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Abstract

Thirty physical education students and 30 music education students read a passage that could be given either a prison break or a wrestling interpretation, and another passage that could be understood in terms of an evening of card playing or a rehearsal session of a woodwind ensemble. Scores on disambiguating multiple choice tests and theme-revealing disambiguations and intrusions in free recall showed striking relationships to the subject's background. These results indicate that high-level schemata provide the interpretative framework for comprehending discourse. The fact that most subjects gave each passage one distinct interpretation or another and reported being unaware of other perspectives while reading suggest that schemata can cause a person to see a message in a certain way, without even considering alternative interpretations.

Frameworks for Comprehending Discourse

> This formal and pure condition of sensibility to which the employment of the concept of understanding is restricted, we shall entitle the schema of the concept . . . The concept 'dog' signifies a rule according to which my imagination can delineate the figure of a four-footed animal in a general manner, without limitation to any single determinate figure such as experience, or any possible image that I can represent in concreto, actually presents. This schematism of our understanding, in its application to appearances and their mere form, is an art concealed in the depths of the human soul, whose real modes of activity nature is hardly likely ever to allow us to discover, and to have open to our gaze.
>
> Immanuel Kant, Critique of Pure Reason, 1781, pp. 182-183

Students from first grade through graduate school are expected to learn about most matters from being told. Periodically reformers call for experience-based programs, but nevertheless the schools still have a manifestly literate bias (Olson, 1976). The reliance upon language is based on assumptions so widely taken for granted that they are seldom even expressed, let alone challenged. It is simply assumed that knowledge can be expressed in printed language, and that a skilled reader can acquire knowledge from reading. On this view, each word, each well-formed sentence, and every satisfactory text passage "has" a meaning. The meaning is conceived to be "in" the language, to have a status independent from the speaker and hearer, or author and reader. On this view, a failure to comprehend a nondefective communication can in principle always be traced to a language-specific deficit. This is a theorem which follows directly from the axioms that knowledge is expressible in language and, symmetrically, that the skilled

reader can decode the language into knowledge. Therefore, it is assumed, difficulties in comprehension can be traced to failures of skill. Some of the words may not be in the reader's vocabulary. A rule of grammar may have been misapplied. An anaphoric reference may have been improperly coordinated. And so on.

Our purpose in this paper is to develop a sharply contrasting theory of language comprehension. The theory will be argued with respect to intuitively clear cases drawn from previous research. Next, an experiment will be reported which illustrates a major tenet of the theory. Last, speculative implications will be drawn for instruction in reading, for instruction in which students are expected to learn by reading, and for methods of assessing comprehension of printed material.

Our main thesis is this: the meaning of a communication depends in a fundamental way on a person's knowledge of the world and his/her analysis of the context as well as the characteristics of the message. By "meaning" we intend the full sense of this term including sense, reference, truth value, illocutionary force, perlocutionary effect, and significance. The scope of "context" ranges from local linguistic constraints--for instance, gambler's pick (choice or selection) and miner's pick (ax-like instrument)--to the physical and social milieu of an utterance.

The meanings of the individual words in a sentence clearly depend upon the interaction of world knowledge and context. Consider the sense of the word kicked and the reference of the word ball in the following three sentences (for further examples, see Anderson & Ortony, 1975).

The baby kicked the ball.

The punter kicked the ball.

The golfer kicked the ball.

Obviously the ball is different in each of these cases. The act of kicking also changes, and this is a fact that everyone immediately appreciates. Contrast the hesitant, uncoordinated, perhaps even accidental kick of the infant with the smooth, powerful kick of the punter. Golfers don't ordinarily kick balls; perhaps this one was angry or maybe cheating. In any event, it is apparent that the golfer's kick is different from the baby's or the punter's. These are the sorts of inferences we all make routinely.

That the significance of whole sentences is context-sensitive is nicely illustrated in an example based on Austin (1962), one of the pioneers in natural language philosophy. Imagine the statement The bull is in the field in each of the following circumstances. (1) You are driving past the field in your car. (2) You are sitting in the field having a picnic. (3) You have brought your pure-bred cow to be inseminated. (4) The sentence comes up on a screen in a memory experiment in which you are participating. In case (2), for instance, the statement may signify that you are in danger and had better run, whereas in (4) it doesn't matter whether there is really a bull in the field.

Comprehension of words, sentences, and discourse could not be simply a matter of applying linguistic knowledge. Every act of comprehension involves one's knowledge of the world as well. Several experiments show that extra-linguistic knowledge is incorporated into the mental representations for

sentences (cf. Bransford, Barclay, & Franks, 1972; Anderson & Ortony, 1975). For instance, Schweller, Brewer, and Dahl (1976) compared recall of sentences such as The housewife spoke to the manager about the upcoming baseball game and The housewife spoke to the manager about the increased meat prices. The first sentence tended to be recalled pretty much as it had been presented whereas, as expected, the second sentence often came back The housewife complained to the manager about the increased meat prices. That the second declaration had the illocutionary force of a complaint depended upon a chain of inference that follows from the knowledge that housewives do not like paying higher prices and that a store manager is proximally responsible for raising prices. Surely no one would care to claim that all of the information needed to make the inferences could be found in the syntax of the language and the dictionary entries for the constituent words. Thus, it is apparent that giving the sentence a complaint interpretation hinged on knowledge which was not narrowly linguistic. People spontaneously applied knowledge of consumer economics and meat market politics.

We conclude, then, that more important than structures which are in some sense "in" a text are knowledge structures the reader brings to the text. We shall call these knowledge structures "schemata" following usage that dates to Sir Fredric Bartlett (1932) and Immanuel Kant (1781) before him. Others have referred to such structures as "frames" (Minsky, 1975) or "scripts" (Schank & Abelson, 1975). Schemata represent the generic concepts underlying objects, events, and actions. Schemata are abstract in the sense that they contain a "variable," "slot," or "place holder" for each constituent element in the knowledge structure. An important aspect of a

schema is the specification of the network of relations that hold among the constituents.

Extensive discussions of schema theory can be found elsewhere (see especially, Rumelhart & Ortony, 1976). For the sake of the present paper only a couple of points need to be made. First, it is when the reader has constructed a correspondence between relevant schemata and the givens in a message that s/he has the sense that the message has been comprehended. When the slots are filled with particular cases a schema is said to be "instantiated." The instantiated cases will be the ones required for the representation as a whole to make sense. In other words, comprehension of a message entails filling the slots in the appropriate schemata in such a way as to jointly satisfy the constraints of the message and the schemata.

A text is never fully explicit. A second claim is that schemata provide the basis for filling gaps, the basis for inferential elaboration, the basis for positing states of affairs, not expressly mentioned, that must hold if a passage is to permit of a coherent interpretation. Comprehension involves going beyond the givens in a message, so to speak "reading between the lines." Readers must make logical inferences, pragmatic inferences, coordinate reference, and supply suppositions about an author's intentions. They must make inferences about the motives and mental states of characters, antecedent and consequent events, instrumentality, and illocutionary force as well as propositional content.

The slots in the schemata from which an individual is trying to build an interpretation of a message "beg" to be filled. They must be filled, even when the message contains no direct information, otherwise comprehension

will fail. That instantiation does occur, and how the process might work, has been documented by Anderson, Pichert, Goetz, Schallert, Stevens, and Trollip (in press; see also, Anderson & McGaw, 1973). Sentences were constructed with general terms in the subject noun position. The remainder of each sentence was designed to cause a certain instantiation of the general term. Here is an example: The woman was outstanding in the theater. Most people will think of this woman as an actress. Later the cues woman and actress were presented. The subject was told to respond with the last word of the related sentence. In each experiment the word naming the expected instantiation was a substantially better retrieval cue than the general term which had actually appeared in the sentence. These results are very difficult to accommodate within any theory that presumes that the meaning of a sentence is some concantenation of the abstract meanings of the constituent words.

Controls were included to rule out the interpretation that the results were due to preexisting associations between the particular terms and the instantiation-guiding elements of the target sentences. For example, the sentence The woman worked near the theater does not produce an actress instantiation, yet actress would be a better cue for theater than woman, given this sentence, if the association between the former two words were of overriding importance. This did not turn out to be the case. On the other hand, the results can be given a straightforward interpretation within the framework of schema theory: The interplay between the schemata for theater and outstanding may be supposed to deliver the implication that a person can be outstanding in the theater by doing an excellent job of acting.

Therefore, the woman mentioned is likely to be a woman who acts, and a woman who acts is an actress--hence, the efficacy of the actress cue. The general point is encapsulated in the slogan; "abstract schemata program individuals to construct concrete scenarios" (Anderson, 1976).

The third and final claim is that high-level schemata tune people to see messages in certain ways (Bransford & McCarrell, 1974; Bransford, Nitsch, & Franks, 1976). The word "see" is intended in an ordinary language sense. We mean, simply, that at a very early stage in processing high-level schemata can cause a person to give one interpretation to a passage without even considering other possible interpretations. To be sure people can consider alternative interpretations. They no doubt sometimes change interpretations when it proves difficult to assimilate the text to the schemata first tried, as for instance happens when a short story has a surprise ending. Nonetheless, we shall argue that dominant high-level schemata are often imposed on text even when, according to a third party point of view, some violence is done to the "data" contained in the text. The strictly left-to-right, or "bottom up," theories of reading comprehension proposed by some (Gough, 1972; LaBerge & Samuels, 1974), which involve a linear progression of processing from visual input through eventually to a meaning, are not regarded as plausible. Of course the truth surely lies somewhere in between. Reading could not be either a top down or a bottom up process; as we have argued here and elsewhere (cf. Anderson & Ortony, 1975) it must involve both.

The purpose of the experiment described herein was to determine whether people from different backgrounds who, therefore, have different systems of knowledge and belief about the world, would "see" the same text passages in

different ways. The research used the techniques developed originally by Schallert (1976). She wrote passages capable of two distinct interpretations. Contexts in the form of titles biasing the interpretation in one direction or the other accompanied each passage. Performance on disambiguating multiple-choice tests indicated that context was a powerful determiner of the interpretations given the passages. Like Schallert, we employed passages that could be interpreted in more than one way. However, instead of providing disambiguating contexts, we selected subjects with different backgrounds. The prediction was that the high-level schemata the subject brought to the experiment would determine his/her interpretation.

Method

Subjects

The subjects were 30 students from a section of an educational psychology course (all female) designed specifically for persons planning a career in music education, and 30 students from two weight-lifting classes (all male), who it could be assumed were generally interested in and knowledgeable about wrestling. Participation in the study was voluntary, though students in the educational psychology class were required to participate in some research during the semester. An additional 60 undergraduates enrolled in an introductory psychology course participated in a subsidiary study.

Materials

Two passages of about 145 words in length were written. Each could be given at least two distinct interpretations. Pilot data indicated that

the typical person interprets the first passage as about a convict planning his escape from prison, though it can be interpreted as about a wrestler trying to break the hold of an opponent. This will be called the Prison/Wrestling passage.

> Rocky slowly got up from the mat, planning his escape. He hesitated a moment and thought. Things were not going well. What bothered him most was being held, especially since the charge against him had been weak. He considered his present situation. The lock that held him was strong but he thought he could break it. He knew, however, that his timing would have to be perfect. Rocky was aware that it was because of his early roughness that he had been penalized so severely--much too severely from his point of view. The situation was becoming frustrating; the pressure had been grinding on him for too long. He was being ridden unmercifully. Rocky was getting angry now. He felt he was ready to make his move. He knew that his success or failure would depend on what he did in the next few seconds.

Preliminary research indicated that the second passage is usually interpreted as about a group of friends coming together to play cards. The alternative interpretation is in terms of a rehearsal session of a woodwind ensemble. This text will be called the Card/Music passage.

> Every Saturday night, four good friends get together. When Jerry, Mike, and Pat arrived, Karen was sitting in her living room writing some notes. She quickly gathered the cards and stood up to greet her friends at the door. They followed her into the living room but as usual they couldn't agree on exactly what to play. Jerry eventually took a stand and set things up. Finally, they began to play. Karen's recorder filled the room with soft

and pleasant music. Early in the evening, Mike noticed Pat's hand and the many diamonds. As the night progressed the tempo of play increased. Finally, a lull in the activities occurred. Taking advantage of this, Jerry pondered the arrangement in front of him. Mike interrupted Jerry's reverie and said, "Let's hear the score." They listened carefully and commented on their performance. When the comments were all heard, exhausted but happy, Karen's friends went home.

Ten multiple-choice questions were generated for each of the two passages. Each question had two correct answers, one for each interpretation. One of the distractors was consistent with one of the expected interpretations, the other with the second interpretation. A sample question for each paragraph follows:

Prison/Wrestling passage

How had Rocky been punished for his aggressiveness?

A) He had been demoted to the "B" team.
B) His opponent had been given points.
C) He lost his privileges for the weekend.
D) He had been arrested and imprisoned.

Card/Music passage

What did the four people comment on?

A) The odds of having so many high cards.
B) The sound of their music.
C) The high cost of musical instruments.
D) How well they were playing cards.

Design and Procedure

Subjects participated in groups ranging from 2 to 15. They read the first passage, completed an interpolated vocabulary test, attempted a free recall of the first passage, read the second passage, worked on another form of the vocabulary test, attempted a free recall of the second passage, and then completed the multiple-choice tests for both passages. Passage order was counterbalanced. The order of the multiple-choice tests matched passage order. Finally, subjects completed a debriefing questionnaire and autobiographical inventory. The items in the inventory were intended to tap matters which could be expected to relate to the interpretations given to the passages. Sample questions: Do you have a close relative who is a law enforcement officer? Have you ever attended a wrestling match? How much do you enjoy playing cards? What does "forte" mean? Will your career depend in any way on music?

Materials were bound into experimental booklets in the order in which they were to be completed. Subjects were allowed 1.5 minutes to read each passage, 6 minutes for each version of the vocabulary test, and 5 minutes for each recall test. The multiple-choice tests, questionnaire, and inventory were subject paced.

Results

Performance on Multiple-Choice Tests

Table 1 contains the mean proportions of answers correct according to the nondominant or secondary interpretation of the passages; in other words, a wrestling interpretation of the Prison/Wrestling passage and a music

interpretation of the Card/Music passage. It should be emphasized that to get a high score the subject had to learn and remember the information in the passage, not merely view it from a certain perspective. Analysis of

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Insert Table 1 about here

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variance indicated, as expected, that there was a significant (α = .01 for this and all subsequent tests of significance) interaction between passage and subjects' background, $F(1,58) = 48.61$. Neither passage nor background had an overall effect. However, both simple main effects were significant; physical education students gave more correct wrestling-consistent answers than music students on the Prison/Wrestling test, $t(58) = 5.60$, whereas the reverse was true with respect to correct music-consistent answers on the Card/Music test, $t(58) = 6.53$.

When correct answers from both perspectives were counted, there was a significant effect for passage, $F(1,58) = 19.27$, but not for background of the subject or the interaction of passage and background. This means that the sheer amount of information acquired did not depend on the interpretation given. Figure 1 shows that scores on the multiple choice tests formed

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Insert Figure 1 about here

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a U-shaped distribution. The graph contains the number of responses correct according to the nondominant interpretation divided by the responses that are correct according to either interpretation. Thus, a low score reflects a dominant interpretation, a middle score a mixed interpretation, and a high score a nondominant interpretation. Figure 1 was constructed from

pooled data, but the distributions were the same when passages and groups were considered separately. It is evident that most subjects gave each passage one distinct interpretation or the other.

Total idea units recalled. The passages were parsed into idea units and scored for gist or substance. Based on independent scorings of 12 randomly chosen protocols interrater agreement was .70. The only significant result was the main effect for passage, $F(1,58) = 7.34$. Subjects recalled a mean proportion of .36 of the idea units in the Card/Music passage and .31 of the units in the Prison/Wrestling passage. The failure to find any significant effects involving subjects' background indicates that this factor did not influence the total amount learned and remembered.

Theme-revealing disambiguations and intrusions. A disambiguation is a paraphrase of an idea unit that clearly shows the subject's underlying interpretation. A theme-revealing intrusion is a phrase or sentence not directly related to any idea unit in a passage. Table 2 gives examples of

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Insert Table 2 about here

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theme-revealing disambiguations and intrusions. The ratio of total disambiguations to total number of idea units recalled that any subject disambiguated was .17. In other words, disambiguations occurred about one out of every six possible times. Looking at the data another way, one or more disambiguations appeared in .69 of the protocols. The comparable figure for intrusions was .26.

Fisher exact tests indicated that theme-revealing disambiguations and intrusions were significantly related to subjects' backgrounds in the manner

that would be expected. More physical education than music students revealed in their protocols a wrestling interpretation of the Prison/Wrestling passage and a card interpretation of the Card/Music passage. Whereas, more music than physical education students included material showing a prison interpretation of the Prison/Wrestling passage and a music interpretation of the Card/Music passage.

As a check on the internal consistency of the data, disambiguations and intrusions that appeared in free recall were compared to performance on the multiple choice tests. When the subjects' interpretations of the passages were classified by splitting multiple choice scores at the median, 92.4% of the disambiguations and intrusions were consistent with this classification. Many of the inconsistent cases appeared to be attributable to a couple of arbitrary conventions for coding disambiguations. For example, the sentence from the Card/Music passage, Mike noticed Pat's hand and the many diamonds, was always scored as a music disambiguation if the subject indicated that diamonds referred to precious stones, but, of course, a card player can wear a diamond ring or bracelet as well as have a long diamond suit. When this and one other idea unit were discounted, 96.1% of the disambiguations and theme-revealing intrusions were consistent with the classifications based on the multiple choice tests.

Autobiographical inventory. Multiple regression analyses were done for each passage using the relevant questions from the inventory as the predictors. The multiple choice score was the criterion variable. Multiple correlations of .52 and .79 were obtained for the Prison/Wrestling and Card/Music passages, respectively.

A subsidiary study was completed with a heterogeneous, unselected sample of subjects to confirm that it is possible to predict from background information the interpretation that will be given to a passage. A total of 60 undergraduates enrolled in an introductory psychology course read the Card/Music passage, completed the multiple choice test, and filled out a modified version of the autobiographical inventory. The multiple correlation between the items on the inventory and performance on the multiple choice test was .53.

We have no doubt that were we to develop more extensive background and interest inventories, engage in empirical trial and error, employ more sophisticated techniques to wring error out of the data, and so on, it would eventually be possible to predict interpretations of these passages with a very high degree of accuracy. But accounting for more variance would serve no useful purpose. The point of theoretical importance is made by the analyses in hand: the interpretation people give to messages is influenced by their backgrounds.

Debriefing questionnaire. The main issue we wished to investigate with the debriefing questionnaire was whether subjects became aware that there was more than one possible interpretation of a passage. Subjects were asked, "Were you aware of another interpretation for either passage? If so, what was it?" If the answer to the first question was "yes," the subject was also asked when s/he became aware of the alternative. Averaging across the two passages, 62% of the subjects reported that another interpretation never occurred to them, while an additional 20% said they became aware of an alternative during the multiple choice test or when responding to the debriefing questionnaire. Less than 20% said they were aware of a second interpretation

while reading a passage. The figures just cited include only subjects who wrote down a sensible alternative interpretation on the debriefing questionnaire. Only 23% would be counted as being aware of another interpretation during initial reading, even if the requirement of providing a coherent statement of the second theme were dropped.

Discussion

Converging evidence obtained in the present study indicates that people's personal history, knowledge, and belief influence the interpretations that they will give to prose passages. There was a striking relationship between the special interest group of which a subject was a member and his/her scores on disambiguating multiple choice tests. Theme-revealing disambiguations and intrusions in free recall showed equally strong relationships to the subject's background. Items from an autobiographical inventory were good predictors of the interpretations that were given to passages. Taken together, these results support unequivocally the claim that high-level schemata provide the interpretive framework for comprehending discourse.

The data were consistent with the second claim that high-level schemata cause people to "see" messages in certain ways. The fact that U-shaped distributions of scores appeared on the multiple choice tests indicates that subjects generally gave a passage one distinct and consistent interpretation or another. Most telling were the reports on the debriefing questionnaire. Over 80% of the subjects reported being unaware of an alternative interpretation when reading a passage. Because of the dominance of behaviorism over the past half century, American social scientists tend to

be suspicious of self-reports. This is a methodological prescript that ought to be thrown on the scrap heap. When one talks to individual subjects, as we have done, one is persuaded that they can reflect accurately on their mental processes. Our data are suggestive at the very least. The possibility that high-level schemata can influence a person to impose one framework on a message, without deliberately or even subconsciously considering others, deserves to be seriously entertained.

In his classic book, Remembering, Bartlett (1932) argued that language comprehension is a constructive process and that memory for linguistic material is reconstructive in character. As evidence, Bartlett recounted informal analyses of attempts to recall the story, The War of the Ghosts, reporting intrusions and distortions that did not have even an inferential basis in the text. Bartlett (1932, p. 204) concluded, "The first notion to get rid of is that memory is primarily or literally reduplicative, or reproductive . . . In the many thousands of cases of remembering which I have collected . . . literal recall was very rare." However, a review by Spiro (1976) indicates that researchers following Bartlett generally have been unable to replicate his finding of gross inaccuracy. Recall tends to be confined to explicit text elements and inferences logically derivable from text elements. Indeed, Zangwill (1972) concluded that the data were sufficient to reject Bartlett's theory.

The present study and several other recent ones (Brown, 1976; Spiro, 1976; Sulin & Dooling, 1974) do show predictable intrusions from the subjects' knowledge of the world. How are these findings to be reconciled with the results obtained by most other investigators in the forty-five years since

Bartlett's book was first published? Schema theory provides a simple answer. Intrusions appear and ambiguous material is distorted in order to place the message and subsuming schemata in correspondence. Distortions and intrusions will appear only when there is a lack of correspondence between the schemata embodied in the text and the schemata by which the reader assimilated the text. This can happen when the text is incompletely specified and the reader fills the gaps (Johnson, Bransford, & Soloman, 1973; Kintsch, 1972); when the set of relations expected on the basis of a schema is deliberately distorted by the author (Spiro, 1976); when the schemata employed by the reader are incongruent with the schemata of the author; or finally when the text is capable of being assimilated to more than one high-level schemata, as in the present study. Most investigators have employed passages in which author, reader, and later the persons who scored the recall protocols have shared schemata, and thus have given common interpretations of the passages. Meyer (1975) is no doubt right when she says that Bartlett observed many intrusions because of the bizzare nature of his stories, but she is wrong to dismiss his results for this reason. Bizzare and ambiguous passages are useful tools for making transparent the role played by knowledge of the world in language comprehension. However, there is no reason to suppose that it is only when attempting to understand passages of this sort that subjects bring to bear extralinguistic knowledge. Indeed, there is every reason to believe that language comprehension always involves using one's knowledge of the world.

We turn now to several interesting implications of schema theory for education. Consider first speculative implications for reading instruction. It may turn out that many problems in reading comprehension are traceable to

deficits in knowledge rather than deficits in linguistic skill narrowly conceived; that is, that young readers sometimes may not possess the schemata needed to comprehend passages. Or, they may possess relevant schemata but not know how to bring them to bear. Or, they may not be facile at changing schemata when the first one tried proves inadequate; they may, in other words, get stuck in assimilating text to inappropriate, incomplete, or inconsistent schemata. Worst of all, it is not unreasonable to suppose that the frequent demand for veridical reproduction in oral and written exercises may bias children against bringing high-level schemata into play at all. For if the child seriously brings his/her own knowledge to bear s/he will, from an adult point of view, often make mistakes. It is the teacher's responsibility to purge errors. Thus, children may sometimes learn from the very lessons intended to upgrade comprehension skills that its best to play it safe, to read word by word and line by line.

From the perspective of schema theory, the principal determinant of the knowledge a person can acquire from reading is the knowledge s/he already possesses. The schemata by which people attempt to assimilate text will surely vary according to age, subculture, experience, education, interests, and belief systems. Merely laying on a new set of propositions will not necessarily change high-level schemata. Wyer (1976) has summarized social psychological evidence in support of this premise, indicating that it is "likely that the implications of new information will be resisted if its acceptance would require a major cognitive reorganization, that is, if it would require a change in a large number of other logically related beliefs in order to maintain consistency among them." Apparent inconsistencies and

counterexamples often are easily assimilated into the schemata a person holds dear. Or, it may be possible for a student to maintain the particular identity of lesson material, keeping it segregated from logically incompatible beliefs.

Experience in helping to revise an introductory college economics course has suggested that the typical freshman or sophomore comes to class with a point of view more akin to Adam Smith than John Maynard Keynes. Our conjecture is that many students can complete an economics course, acquiring a large amount of information and a number of concepts and principles in a piece-meal fashion, without integrating the new learnings into existing knowledge structures, and without understanding the Weltanschauung of contemporary economics.

Driver and Easley (1969) and Driver (1973) found that people have a comparable difficulty in acquiring the conceptual frameworks of physics. They interrogated gifted high school physics students about the movement of balls, launched by a spring plunger, along a horizontal track. While students used the terminology of Newtonian mechanics, such as "force," "momentum," and "impulse," many of them "manifested the Aristotelian notion that constant force is required to produce constant motion." Driver and Easley (1969, p. 1) concluded "that the student . . . has already developed many concepts from his experience with the physical world, which influence his understanding of the new evidence and arguments . . ." Driver (1973, pp. 423-424) added that, "The belief system they use in school to pass examinations and satisfy the teacher . . . may never be related to that which is used in everyday experience."

We shall note, finally, an implication of schema theory for the assessment of comprehension. The fact that theme-revealing disambiguations do appear, and that these are significantly related to the subject's background, has been stressed. But perhaps an equally important point is how difficult it is to tell from a recall protocol what interpretation a subject has given to a passage. Most subjects gave one distinct interpretation or another to each passage. Yet nearly one third of the protocols contained no clear indication of the underlying interpretation. Our passages were written to permit of starkly contrasting interpretations. The manifest differences between, say, a classical and a Keynesian view of economics would probably be much more subtle. This is a point of major significance for the assessment of comprehension. As both Spiro (1976) and Anderson (1976) have argued, the teacher has his/her schemata, too. The easy assimilation is that "mistakes" and "gaps" in an essay answer are blemishes rather than signs of what is possibly a wholly different point of view.

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Table 1

Mean Proportions Correct on the Multiple Choice Tests

	Subjects' background	
Passage	Physical Education	Music
Prison/Wrestling	.64	.28
Card/Music	.29	.71

Note:--Tests scored for answers correct on the basis of the nondominant interpretation. A high score reflects a wrestling interpretation of the Prison/Wrestling passage and a music interpretation of the Card/Music passage.

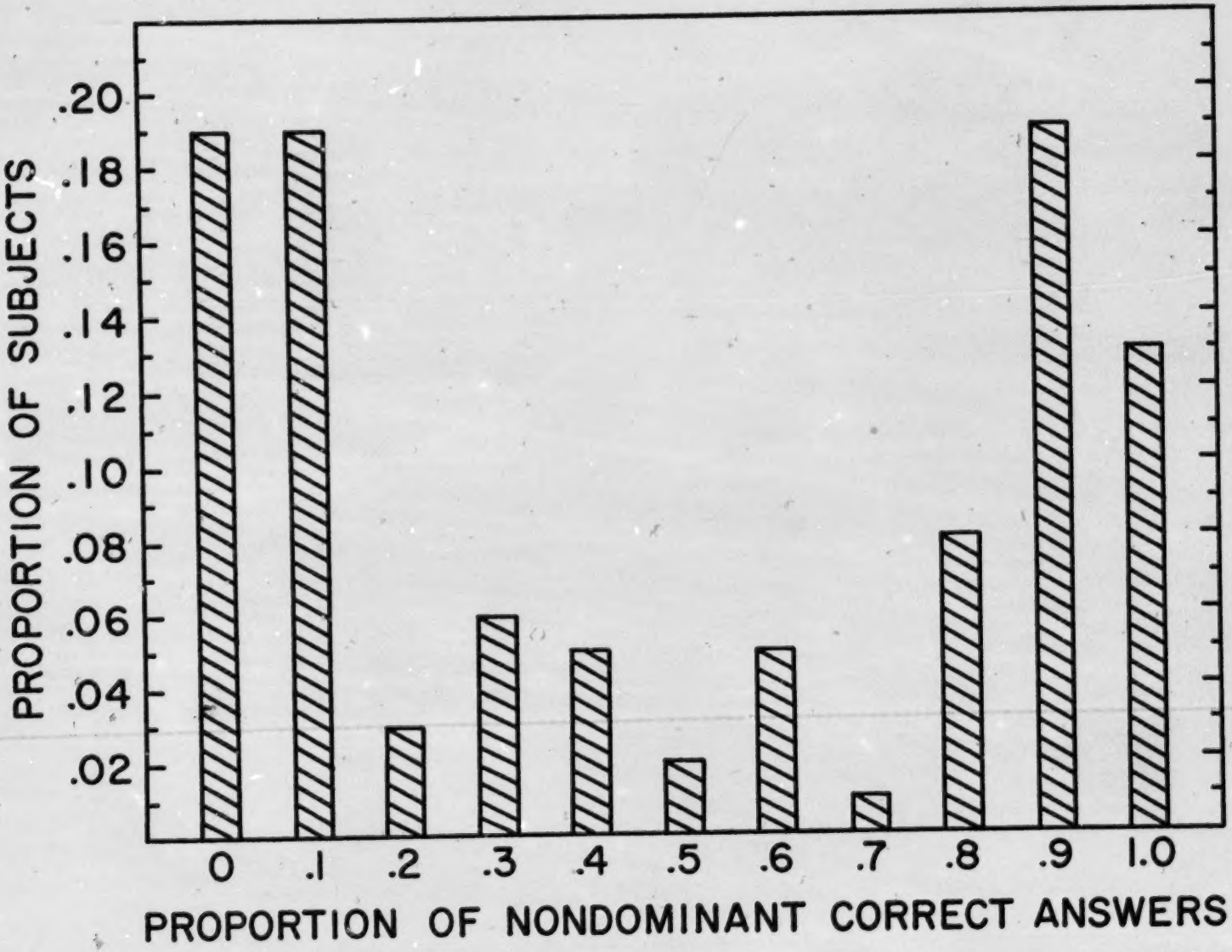
Table 2

Examples of Theme-Revealing Disambiguations and Intrusions

Prison theme	
	Rocky sat in his cell.
	He was angry that he had been caught and arrested.
Wrestling theme	
	Rocky is wrestling . . .
	Rocky was penalized early in the match for roughness or a dangerous hold . . .
Card theme	
	She is playing with a deck of cards.
	Mike sees that Pat's hand has a lot of hearts.
Music theme	
	Mike brought out the stand and began to set things up.
	As usual they couldn't decide on the piece of music to play.

Figure Caption

Figure 1. Distribution of multiple choice test scores.


PROPORTION OF SUBJECTS
.20
.18
.16
.14
.12
.10
.08
.06
.04
.02
0
.1
.2
.3
.4
.5
.6
.7
.8
.9
1.0
PROPORTION OF NONDOMINANT CORRECT ANSWERS